REMARKS

Claims 1-38 are pending in this application. No amendment has been made in this Response.

Claims 13-19 and 32-38 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite (Office action points 2-3).

The Examiner states that claims 13 and 32 "show acceptor and/or donor levels that are nonuniformly formed in the quantum well structure. Claims 14 and 33 show acceptor levels as being more on one side. ... The description in the claims shows a situation that is not physically possible."

Reconsideration of this rejection is respectfully requested.

Applicants submit that the claims do **not** recite a situation that is not physically possible. In the Examiner's remarks concerning "how one can form energy levels in a quantum well that are on one side", the Examiner appears to misinterpret the specification as stating that donor and/or acceptor levels are nonuniformly formed by nonuniformly forming quantum levels of quantum wells. The specification, however does not state that donor and/or acceptor levels are nonuniformly formed by nonuniformly forming quantum levels of quantum wells.

It is known that donor and/or acceptor levels are formed also by lattice defects such as vacancy. It is therefore considered that a physically possible method other than uniform doping is to nonuniformly form donor and/or acceptor levels by making the density of vacancy nonuniform. In a nitride-based semiconductor, for example, it is known that nitrogen vacancy serves as donors.

The most usual method for forming donor and/or acceptor levels is a method for doping

impurities. Accordingly, nonuniform doping is considered as the method for nonuniformly forming donor and/or acceptor levels. The specification describes nonuniform doping as the method for nonuniformly forming donor and/or acceptor levels. Applicants refer to the specification on page 89, lines 12 to 16, in this regard.

Claims 1, 5, 9, 12, 20, 24, 28 and 31 are rejected under 35 U.S.C. 102(e) as being anticipated by Landwehr et al. (Office action points 6-9)

The Examiner cites Landwehr's Fig. 2 and column 5, line 22 et seq.. With regard to claim 20, the Examiner has taken Landwehr's first waveguide layer 6 (p-InGaAlAs) as the first p-type layer; thin barrier layer 10 as the first n-type layer; quantum well structure 5 (InGaAs) as the light emitting layer; and spacer layer 4 (p-InGaAlAs) as the second p-type layer. The Examiner states that "the piezoelectric effect is inherent in the structure ...."

Reconsideration of this rejection is respectfully requested.

In traversing the rejection, Applicants submit that "strain generating a piezoelectric effect" would **not** be inherent in Landwehr et al. Applicants first note that the terms "strain" and "piezoelectric" do not occur in Landwehr et al..

As to the **piezoelectric effect**, Applicants note that descriptions as to conditions for generating an electric field due to a piezoelectric effect are made in the present specification, from page 89, line 17 and thereafter. In particular, a crystal having a zinc-blende structure is described in page 92, lines 2 to 20.

Although Landwehr et al. recites a zinc-blende type semiconductor, this reference fails to

describe its principal-plane direction. As described in the specification of the present application, page 92, lines 2 to 20, even if a light emitting layer has strain, no electric field is generated in quantum wells due to the piezoelectric effect when the quantum wells are stacked in a principal-plane direction equivalent to [001] or [110]. In the case of a light emitting device composed of a zinc-blende type semiconductor, most of quantum wells are stacked on a (001) substrate. Especially in the case of a light emitting device employing AlGaInAs on InP, a (001) substrate is usually used. Thus, even if a light emitting layer has strain, no electric field is generated in quantum wells due to the piezoelectric effect. In other words, "the piezoelectric effect" per se is not inherent in Landwehr et al. Moreover, the direction of potential gradients resulting from the electric field due to the piezoelectric effect is dependent on materials, principal plane-direction and on whether strain is compression or tensile. Since Landwehr et al. fails to describe the principal-plane direction, the patent describes nothing about the direction of potential gradients.

Landwehr et al. fails to clearly describe **strain**. It is, however, natural that strain is applied in case of the light emitting device employing AlGaInAs on InP. Even if strain is applied, the direction of potential gradients resulting from the electric field due to the piezoelectric effect is dependent on materials, principal plane-direction and on whether strain is compression or tensile. Since Landwehr et al. fails to clearly describe whether strain is compression or tensile, the reference describes nothing about the direction of the potential gradient.

Applicants therefore submit that claims 1, 5, 9, 12, 20, 24, 28 and 31 are not anticipated by Landwehr et al.

Claims 2 and 21 are rejected under 35 U.S.C. 103(a) as being unpatentable over Landwehr et al. in view of Hashimoto (U.S. Patent No. 6,411,637) (Office action points 11-12).

The Examiner again cites Landwehr et al. as teaching the first p-type layer, first n-type layer, light emitting layer and second p-type layer of claim 20 (and presumably also the second n-type layer of claim 1) and also again states that the "strain generating a piezoelectric layer" is inherent in the prior art.

Reconsideration of this rejection is respectfully requeseted.

Applicants have argued above that the "strain generating a piezoelectric layer" is **not** inherent in Landwehr et al. Applicants also assert that there is no suggestion in Landwehr et al. for this limitation. Hashimoto also fails to clearly describe a principal-plane direction or strain, and therefore also fails to clearly describe a piezoelectric effect. Applicants accordingly submit that no *prima facie* case of obviousness can be made using the combination of Landwehr et al. and Hashimoto.

Applicants therefore assert that claims 2 and 21 are novel and non-obvious over Landwehr et al. and Hashimoto, taken separately or in combination.

Claims 3, 4, 6, 7, 8, 10, 11, 22, 23, 25, 26, 27, 29 and 30 are rejected under 35 U.S.C. 103(a) as being unpatentable over Landwehr et al. (Office action points 14-15).

Reconsideration of the rejection is respectfully requested.

Applicants have argued above traversing the rejection of base claims 1 and 20 under 35 U.S.C. 102 over Landwehr et al., that the "strain generating a piezoelectric layer" is **not** inherent in Landwehr et al., and have also argued that this limitation is not suggested by the reference.

Accordingly, no *prima facie* case of obviousness can be made for claims 3, 4, 6, 7, 8, 10, 11, 22, 23, 25, 26, 27, 29 and 30 over Landwehr et al.

Claims 13-19 and 32-38 are rejected under 35 U.S.C. 103(a) as being unpatentable over Landwehr et al. in view of Otsuka et al. (U.S. Patent No. 6,110,756) (Office action points 16-18).

Reconsideration of the rejection is respectfully requested.

Applicants have argued above traversing the rejection of base claims 1 and 20 under 35 U.S.C. 102 over Landwehr et al., that the "strain generating a piezoelectric layer" is **not** inherent in Landwehr et al., and have also argued that this limitation is not suggested by the reference. Applicants also note that Otsuka et al. describes strain quantum wells, but describes that a principal-plane direction of a substrate is (001) which is therefore not the principal-plane direction generating the piezoelectric effect. Applicants therefore submit that no combination of the references provides this limitation of the claims, and that no *prima facie* case of obviousness can be made for claims 13-19 and 32-38 using these references.

Moreover, in Otsuka et al., it is certain that acceptor levels are nonuniformly formed in a barrier layer; however, only a central portion of 33b is doped, and a doping profile is symmetrical with respect to a thickness direction of the barrier layer. Therefore, Otsuka et al. is distinguished from claims 14 to 17 and 33 to 36. Also, since only acceptor levels are formed in Otsuka et al., it is different from claims 18 to 19 and 37 to 38. Further, even if the barrier layer of Otsuka et al. is adapted to a quantum well structure having a piezoelectric effect, it does not provide an effect of

reducing potential gradients of the piezoelectric effect since the doping profile is symmetrical with respect to the thickness direction of the barrier layer. Thus, Otsuka et al. is also different from claims 13 to 32.

Applicants therefore assert that claims 13-19 and 32-38 are novel and non-obvious over Landwehr et al. and Otsuka et al., taken separately or in combination.

If, for any reason, it is felt that this application is not now in condition for allowance, the Examiner is requested to contact Applicant's undersigned agent at the telephone number indicated below to arrange for an interview to expedite the disposition of this case.

In the event that this paper is not timely filed, Applicant respectfully petitions for an appropriate extension of time. Please charge any fees for such an extension of time and any other fees which may be due with respect to this paper, to Deposit Account No. 01-2340.

Respectfully submitted,

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